10/575910
IAP15 Rec'd PCT/PTO 14 APR 2006

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re patent application of

Thomas FEITH et al.

Corres. to PCT/EP2004/011591

For: COMPONENT FOR A MOTOR VEHICLE

VERIFICATION OF TRANSLATION

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

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April 12, 2006

Date

Name: C. E. SITCH

For and on behalf of RWS Group Ltd

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Component for a motor vehicle

The invention relates to a component, in particular a crossmember, for arranging between the A-pillars of a motor vehicle, with a basic body made from metal which is of essentially tubular design or is designed in the form of an elongated shell, i.e. an open profile, and with a duct, in particular ventilation duct, of plastic which is at least partially surrounded by the profile of the basic body and is connected mechanically thereto. A component of this type is known from DE 100 64 522 A1, for example.

In a motor vehicle, a saving on weight and/or construction space is possible by a crossmember connecting the A-pillars being used at the same time for guiding air. By lining the crossmember with plastic, both the stability of the crossmember can be increased and the probability of condensation from moisture contained in the air-conditioned air to be supplied to the vehicle interior can be reduced. Connecting points for further components, for example steering column or airbag, are typically arranged on the crossmember. Connecting points of this type are generally realized by joining parts welded to the crossmember. However, because of the thin-walled design of the crossmember that has only been made possible by the stabilizing plastic lining, the production of welding connections on the crossmember is problematic. The application of heat to the outer side of the crossmember very rapidly brings about an increase in temperature on its inner side, which can damage the plastic forming a ventilation duct. Furthermore, it is also possible for gas to be produced by the heated plastic or by evaporation of surface coatings, for example zinc layers. This gas may penetrate the molten metal of the weld seam and form pores or blow the liquid welding material out of the weld seam.

The invention is based on the object of indicating a component, in particular a crossmember of a motor vehicle, which comprises an elongated basic body made from metal and a duct, in particular ventilation duct, of plastic connected mechanically thereto, and is distinguished by particularly economical production and further processing possibilities.

This object is achieved according to the invention by a component with the features of claim 1. In this case, a duct formed at least primarily from plastic is connected mechanically to a metallic basic body essentially having the form of a tube or an open profile, in particular crossmember between the A-pillars of a motor vehicle. The basic body or a part connected rigidly thereto has at least one joining point for connection with a cohesive material joint to a joining part provided for the fastening of a further component. At least in the region of the joining point, the basic body, the part connected rigidly thereto and/or the duct has a form making it possible for an intermediate region to be provided between the joining point and the plastic forming a wall of the duct. The intermediate region reduces the heat transfer between the joining point and the plastic of the duct. The duct wall, which is at least predominantly formed from plastic, is therefore not disadvantageously affected by the application of heat at the joining point. In addition, if corresponding temperatures of the plastic are reached, the intermediate region preferably acts as a degassing opening or degassing gap and therefore permits the removal of gas formed from the plastic of the duct or from material evaporating from surface layers during the joining, in particular welding.

In a particularly economical manner, the duct is preferably connected to the profile of the basic body by means of the injection molding method in a force-

transmitting manner. In this case, the plastic of the duct penetrates openings in the basic body during the injection molding method, so that the hybrid component produced in this manner has connecting elements, which are formed by the plastic in the manner of rivet connections. Additional connecting elements between the basic body, in particular crossmember, and the duct, in particular ventilation duct, are not required in this production method. The component is preferably designed geometrically in such a manner that, in order to produce the duct in the injection molding method, just a simply constructed injection mold, ideally in the form of what is referred to as an open-closed mold without or with a small number of additional slides, is required. Alternatively, however, the duct may also be premanufactured and connected mechanically to the component by adhesive connections, clip connections, collar-type joining and/or in another manner.

Irrespective of the production method, in particular IMA method (In-Mold Assembly) or PMA method (Post-Mold Assembly), the duct is already arranged in or on the component before the joining part, which serves, for example, for the fastening of an airbag or for the mounting of the steering column, is connected thereto with a cohesive material joint. By not connecting the joining part to the basic body until after the duct is introduced into the basic body or the duct is connected to the basic body, tolerance problems which are to be anticipated in other situations are avoided. Furthermore, this makes it possible in particular to produce economical manufacturing by injection molding with production at the same time of a strength-transmitting connection to the basic body without using complicated slides or sealing devices at the joining points.

According to a preferred refinement, the joining point is situated directly on the basic body. In this

connection, if it is possible when the strength requirements are taken into consideration, the insertion of reinforcing additional parts, such as plates, into the profile of the basic body in the region of the joining point is omitted. In the region provided for the fastening of the joining part with a cohesive material joint, the basic body preferably has an embossed structure, in particular a knob or rib structure, which ensures that the joining point is spaced apart from the plastic of the duct. It is therefore possible solely by the form of the basic body to produce a spacing between the joining part and parts of the component which are formed from plastic, said spacing reducing the heat transfer between the joining point and the plastic. The embossed structure is preferably designed in such a manner that the wall of the duct, which is otherwise formed from plastic, is formed in the intermediate region adjoining the joining point exclusively from the material of the basic body. This can be realized in terms of manufacturing in a simple manner by the knobs, ribs or other embossed structures of the basic body being impressed from the outer side thereof to such a depth that the plastic applied to the inner side of the profile of the basic body to produce the duct only forms a wall of the duct in surface regions of the basic body outside the knobs, ribs or similar depressions - as viewed from the outer side of the profile. By contrast, in the region of the depressions mentioned, the wall of the duct is formed by the material of the basic body. An overall smooth, inner surface of the duct can be produced by the sum of the embossed depth of the embossed structure of the basic body and of the wall thickness of the basic body corresponding at least approximately to the wall thickness of the duct in the region outside the depressions. Overall, the inner surface of the duct, including the depressions which do not have any plastic, is formed for the most part from plastic, so that the condensation problems typically arising in the

case of ducts made from metal are avoided. Furthermore, the embossed structure of the basic body at the same time increases the mechanical stability of the component in a particularly advantageous manner.

Despite the good heat conduction of the metallic basic body, regions of the duct wall that are lined with plastic or are formed entirely from plastic are spaced apart sufficiently far from the joining point in order to permit welding at this point. The at least limited thermal decoupling of the joining point from the duct makes it possible for the joining point to be configured with large dimensions with a correspondingly extensive introduction of force from the joining part into the basic body. This is all the more advantageous the thinner-walled the design of the basic body is. The component is therefore of particularly weight-saving design with a great degree of design freedom with regard to the arrangement and form of the joining parts. A particularly uniform, extensive introduction of force is preferably provided by the fact that the joining part is connected to the basic body with a cohesive material joint, in particular is welded, not only at individual points or lines, in particular outer contours, but also has joining points which extend over relatively large areas, for example in the form of weld seams in the manner of a honeycomb pattern or cross-hatching.

In the region adjacent to the joining point, the basic body preferably has one or more apertures, preferably holes or punched portions, as degassing openings, which form the intermediate region or part of the intermediate region. Degassing openings of this type, for example produced by a laser beam before the welding on of the joining part, are preferably combined with embossed portions of the basic body and/or of the joining part fastened thereon, which form ducts or other cavities through which gases arising during the

joining method can escape. In addition, the joining part preferably also has openings and/or contours interacting with the degassing openings of the basic body.

According to a preferred development, the joining point is formed on at least one bent-outward part of the basic body, which bent-outward part is spaced apart at this point from the duct, in particular ventilation duct, and is bent outward, i.e. points away from the duct. Both a particularly large spacing of the joining point from the plastic of the duct and a particularly extensive connection of the basic body to the joining part can therefore be produced. A particularly economical production of the component is also made possible in this refinement by the fact that the joining point is arranged directly on the basic body, without further auxiliary elements.

In a departure from the previously described, single-part design of the basic body with the joining point arranged on the surface of the duct and/or on the bent-outward part, a separate part, in particular an "insert part", can also be connected, for example welded, to the basic body, which part has the joining point for the connection with a cohesive material joint to a further component. In this case, the insert part preferably has a subregion arranged within the profile of the basic body, i.e. on that side of the basic body which faces the duct, and a subregion protruding out of the duct. The inner subregion is preferably injected into the duct at the same time as the duct is produced in the injection molding method, with, in comparison to an injection mold which is provided for producing a component without additional insert parts or adaptors, the injection mold not being of more complicated design or only being of insignificantly more complicated design, in particular not having an additional slide. In a particularly advantageous manner, an additional

reinforcing of the component is provided by the insert part. The wall thickness of the insert part is preferably dimensioned in such a manner that the wall of the duct is free from plastic in regions in which the insert part bears against the basic body, with an overall at least approximately smooth surface being formed. The insert part therefore forms at least part of the intermediate region between the joining point, in particular welding root, and the plastic wall of the duct. In this case, the joining point is situated on that part of the insert part which is arranged outside the basic body and/or within a surface region of the basic body on which the inner subregion of the insert part rests. In particular in the design with separate insert parts, the component has the advantage that the manufacturing of various variants is possible without or only with slight modification of the basic body serving as the base part.

According to all of the above-explained designs of the component, the intermediate region is primarily produced by the design of a part manufactured from metal in order to protect the plastic of the duct. In a departure from this, or in a combination with these refinements, according to further refinements the at least one intermediate region, which preferably forms both an insulation space and a degassing gap, is produced by the surface structure of the plastic of the duct. This is advantageous in particular in cases in which a premanufactured ventilation duct is connected to the basic body by adhesive bonding and/or mechanical connecting devices. Intermediate regions are formed, for example, by ribs or other elevations of the duct, which is entirely manufactured from plastic, that bear against a essentially smooth inner surface of the basic body.

Irrespective of the geometrical design of the basic body and of the duct, the joining part is preferably

connected to the basic body by means of a low-heat joining process, for example laser welding or electron beam welding. In this manner, even in the case of a thin-walled basic body, at most a small distortion occurs because of the joining.

The advantage of the invention resides in particular in the fact that, in spite of a thin-walled design of the basic body, an economical, reliable, mechanically highly loadable connection of the crossmember to joining parts to be fastened at the joining points is made possible by the strength-transmitting connection of a metallic basic body of a crossmember of a motor vehicle to a ventilation duct having a wall at least predominantly of plastic, and the formation of intermediate regions, which serve to reduce the heat transfer, between joining points arranged directly on the basic body and the plastic of the ventilation duct which is introduced into the basic body in the injection molding method.

A number of exemplary embodiments of the invention are explained in more detail below with reference to a drawing, in which:

Fig. 1 shows the profile of a crossmember according to the prior art,

Fig. 2 shows the crossmember according to fig. 1 with injected ventilation duct according to the prior art,

Figs. 3a, 3b show a component with a crossmember as basic body with injected ventilation duct and joining part, connected with a cohesive material joint, according to the invention,

Figs. 4 to 7 show further exemplary embodiments of components in each case in a view analogous to fig. 3,

Figs. 8a, 8b show an exemplary embodiment of a component with a joining point, which is provided for connection with a cohesive material joint to a joining part, on a bent-outward part of a basic body,

Figs. 9, 10 show further exemplary embodiments of components in each case in a view analogous to fig. 8a,

Fig. 11 shows an exemplary embodiment of a component with isolating intermediate regions formed between the outer surface of a ventilation duct and a basic body,

Fig. 12 shows an exemplary embodiment of a component with a plurality of ventilation ducts,

Figs. 13a, 13b show, in a perspective view and in a partial cross section, a further exemplary embodiment of a component with a joining part welded onto a basic body,

Fig. 14 shows, in detail in a partially cutaway, perspective view, the fastening of a joining part to a component,

Figs. 15a, 15b show, in detail in a perspective view and in cross section, a further exemplary embodiment of a fastening of a joining part to a component,

Figs. 16a to d each show, in a diagrammatic view, the structure of a joining part in plan view or in cross section,

Fig. 17 shows, in cross section, a further exemplary embodiment of a metal/plastic composite component, produced in the PMA method,

Figs. 18a, 18b each show, in a perspective illustration, an exemplary embodiment of a basic body with a joining part fastened thereto,

Figs. 19a, 19b respectively show, in a diagrammatic view, a detail of the basic body and of the joining part according to fig. 18b, and

Figs. 20a, 20b show, in a perspective view and in cross section, a crossmember with injected ventilation duct and additional insert parts.

Parts which correspond to one another or act in an identical manner are provided with the same designations in all of the figures.

Fig. 1 shows, in cross section, a crossmember 1 which is made from metal, is basically known with regard to its function and forms the basic body of a component according to the invention that is explained in more detail below. The crossmember 1, also referred to as instrument carrier, is arranged between the A-pillars of a motor vehicle as a supporting part of the body structure and is used, inter alia, for the mechanical joining of further components, for example of an airbag housing.

The arrangement according to fig. 2, which shows the crossmember 1 with the duct or ventilation duct 2 of plastic with a circular cross section that is integrally formed in the injection molding method is likewise basically known, for example from DE 100 64 522 A1. The ventilation duct 2 which at least slightly increases the stability of the crossmember 1 extends along the crossmember 1 and is therefore used to distribute additional air in the transverse direction of the vehicle.

Figs. 3a and 3b show, in an arrangement analogous to figs. 1 and 2, the basic construction of a component 3 according to the invention. In addition to the basic body or crossmember 1 and to the ventilation duct 2 connected thereto by means of the plastic injection molding method, a joining part 4 merely illustrated in symbolized form is provided here. The joining part 4, like the basic body 1, is manufactured from metal and is fastened thereto by a weld seam 5, referred to in general as joining point. In contrast to the exemplary embodiment according to fig. 2, the basic body 1 in the exemplary embodiment according to fig. 3 has an embossed structure 6 in the form of a knob structure which imparts a substantially improved mechanical stability to it and penetrates the plastic 7 of the ventilation duct 2. In this case, the individual knobs 8 of the embossed structure 6 protrude in the direction of the interior of the duct 2.

While the outer side 9 of the ventilation duct 2 is formed exclusively from the material of the basic body 1 in its top region in the illustration, i.e. above two webs 10 which adjoin the circular ventilation duct 2 in the radial direction as parts of the basic body 1, the inner side 11 has regions made from metal, namely the knobs 8, and otherwise a surface made from plastic 7. The wall thickness of the ventilation duct 2, which wall thickness is approximately constant over the

entire circumference, is denoted by d, the wall thickness of the basic body 1 by a, and the embossed depth of the embossed structure 6 by p. As is apparent in particular from the view of the detail according to fig. 3a, the sum of the embossed depth p and of the wall thickness a of the basic body 1 corresponds to the wall thickness d of the ventilation duct 2. Those inner surface regions of the ventilation duct 2 which are formed from plastic and which extend overall over most of the inner surface of the ventilation duct 2 therefore adjoin the knobs 8 made from metal with a smooth surface being formed. The weld seam 5 is situated in the region of a knob 8, as a result of which an intermediate region 12 separating the joining point 5 from the plastic 7 of the ventilation duct 2 is formed. This intermediate region 12 permits the joining part 4 to be welded onto the basic body 1 after the ventilation duct 2 is formed in the basic body 1, without risk of the plastic 7 being damaged. Conversely, the quality of the weld seam 5 is not impaired by the plastic 7 either.

Figs. 4 to 7 each show, in a specific refinement of the basic example according to figs. 3a and 3b, an exemplary embodiment of a component 3 with a different design of at least one joining part 4. In each case, joining points 5 are situated exclusively in regions of the basic body 1 that have not been encapsulated with plastic 7 during the injection molding method, so that an intermediate region 12 of at least small dimensions is formed. The joining parts 4, which are formed from punched and/or bent plates and are essentially aligned either longitudinally or transversely to the extent of the basic body 1, are welded to the basic body 1 in the region of one or more knobs 8. Holes 13 are provided for the mechanical connection of the joining parts 4 to further components (not illustrated).

The exemplary embodiments according to figs. 8a and 8b to 10 show an alternative arrangement of the joining points 5. In this case, the basic body 1 has in each case at least one bent-outward part 14 which is either bent as a limb 15 out of the basic body 1 or is designed, preferably likewise integrally with the basic body 1, as an oblong or round eyelet 16. As is revealed in fig. 10, a joining part 4 can be fastened to the inside or outside of an eyelet 11. The bent-outward parts 14 are formed before the ventilation duct 2 is introduced into the basic body 1. In particular the view of a detail according to fig. 8b reveals that the plastic 7 also surrounds the basic body 1 on the outer side 9 in the region which is adjacent to an aperture 17 produced by the formation of the bent-outward part 14. This improves the force-transmitting connection between the ventilation duct 2 and the basic body 1.

In the exemplary embodiment according to fig. 11, the basic body 1 has a profile which corresponds to the crossmember 1 according to the abovementioned exemplary embodiment. However, in contrast thereto, the ventilation duct 2 is not injected into the basic body 1 but rather is premanufactured and is subsequently connected to the basic body 1 by adhesive bonding, clipping or collar-type joining. In its region facing the basic body 1, the ventilation duct 2 has, on its outer side, an uneven surface structure with ribs 18 which form a plurality of intermediate regions 12 as insulation spaces between the ventilation duct 2 and the basic body 1. Joining parts 4 are fastened to the basic body 1 exclusively in the region of these insulation spaces 12. If, during the joining of the joining part 4, heating occurs at the joining point 5 leading to the plastic 7 producing gas, the gas escapes through the intermediate regions 12, which are designed as ducts. In a manner not illustrated specifically, if required openings are provided in the basic body 1 for further conducting away of the gas.

Fig. 12 shows an exemplary embodiment of a component 3 having an essentially rectangular cross section within which two rectangular ventilation ducts 2 run. Both ventilation ducts 2 are spaced apart from side walls 19 of the basic body 1 and adjoin a base surface 20 of the basic body 1. Joining points 5 are provided exclusively in regions of the basic body 1 in which no wall of a ventilation duct 2 adjoins the inner side of the plate forming the basic body 1. The welding of a joining part 4 (not illustrated here) onto the basic body 1 therefore causes the plastic 7 at most to be melted locally in regions outside the ventilation ducts 2. To avoid impairing the weld seams 5, in the adjacent regions the plastic 7 advantageously has apertures (not illustrated), for example punched portions. Punched portions of this type, through which the gas formed from the plastic 7 can escape, can also be provided in a corresponding manner in the other exemplary embodiments.

Figs. 13a and 13b show, in a perspective overall view and in a diagrammatic, cutaway view of a detail, the fastening of a joining part 4 with an embossed structure on the smooth surface of a basic body 1. The basic body 1, including the ventilation duct 2 having a circular cross section, is produced as a hybrid component in the injection molding method. The joining part 4 is essentially in the form of a bent sheet-metal strip with a first supporting limb 21 resting on the basic body 1 and a second fastening limb 22 provided for the fastening of a component (not illustrated), for example an airbag. The supporting limb 21 has a central hole 23, the fastening limb 22 has two holes 24. The supporting limb 21 which is curved corresponding to the curvature of the crossmember 1 has an embossed structure 25 which, in plan view, has a crosswise pattern and, in cross section, has a wavy form. Those regions of the embossed structure 25 which rest on the

crossmember 1 form the joining point 5. The intermediate region 12 is formed between those regions of the embossed structure 25 which are spaced apart from the basic body 1 and the surface of the basic body 1. In the region lying opposite the supporting limb 21, the basic body 1 has a number of openings 26 which are used to conduct away gas which has separated off from the plastic 7 or a coating, for example zinc, during the welding as the joining method. The gas which arises is conducted further away from the joining point 5 both at the side edges of the supporting limb 21 and also through the hole 23. The overall approximately sheet-like connection of the supporting limb 21 to the basic body 1 permits, together with the duct 2 which is connected extensively and non-positively to the basic body 1, a lightweight and nevertheless stable design of the component 3.

Fig. 14 illustrates a detail of a further exemplary embodiment of a fastening of a joining part 4 to a basic body 1. In this case, the joining part 4 is only welded to the basic body 1 in the edge regions, with a flat intermediate region 12 which is connected to the outside via a hole 23 being formed in the central region of the supporting limb 21. The openings 26 in the basic body 1 are produced by laser machining, for example before the joining part 4 is welded on. In the illustrated manner or in a similar manner, a multiplicity of joining parts 4 can be connected in a flexible manner in terms of manufacturing to the basic body 1 at any desired points.

In a departure from the exemplary embodiments according to figs. 13a, 13b and 14, figs. 15a and 15b show an exemplary embodiment in which the surface of the basic body 1 is corrugated while the supporting limb 21 welded thereto is flat. In this case, the openings 26 in the basic body 1 are designed as slots.

Figs. 16a to 16c show diagrammatically different designs of the supporting limb 21, namely a pattern of holes (fig. 16a), a honeycomb pattern (fig. 16b) and a combined honeycomb/knob pattern (fig. 16c). The diagrammatic cross section according to fig. 16d relates to each of the exemplary embodiments according to figs. 16a to 16c. In principle, very different surface structures of the supporting limb 21 with depressions and/or elevations can be used. In the region of the joining points 5, the basic body 1 preferably has a surface structure which is matched to them. In this context, the structures illustrated in figs. 16a to 16c also relate to the surface of the basic body 1.

Fig. 17 shows, in a diagrammatic cross section, a further exemplary embodiment of a component 3 with a metallic basic body 1 having an essentially trapezoidal cross section, and a ventilation duct 2 connected mechanically thereto. Joining points 5 for the welding on of joining parts 4 are provided exclusively at those points of the basic body 1 at which no wall of the ventilation duct 2 is situated on the inner side of the profile of the basic body 1. The component 3 is produced, for example, in the PMA method.

The exemplary embodiments according to figs. 18a and 18b show basic possibilities of fastening a voluminous joining part 4 to the basic body 1. In this case, the joining part 4 has a fastening arm 27 which rests on the basic body 1 and is to be welded thereto. Before the welding takes place, the joining part 4 is already held in a form-fitting manner on the basic body 1 by means of the fastening arm 27.

Figs. 19a and 19b show, in schematized form, surface structures of the basic body 1 (fig. 19a) and of the joining part 4 (fig. 19b) in the region of the fastening arm 27 according to fig. 18b. In this case,

openings 26 are provided in the basic body 1 and notches 28 are provided in the fastening arm 27 to permit gas to be conducted away from the plastic 7.

Figs. 20a and 20b show, in a schematized cross section and in a perspective view, an exemplary embodiment of a component 3 which, in addition to the basic body 1 and ventilation duct 2, has a ribbed structure 29 of plastic 7 which is produced together with the ventilation duct 2 in the injection molding method. In this case, the bent-outward parts 14 are not formed from the basic body 1 but rather are designed as insert parts 30 which in each case have an inner section 31 which bears against the inside of the basic body 1, is curved in this exemplary embodiment and the wall thickness of which corresponds at least approximately to the wall thickness d of the ventilation duct 2 minus the wall thickness a of the basic body 1. The inner surface of the ventilation duct 2 is therefore formed partially from plastic 7 and partially from metal comparably to the exemplary embodiment according to figs. 3a and 3b.

The first joining point 5 is situated directly on the outer side of the basic body 1, on the left in fig. 20a. Owing to the fact that the plastic 7 on the inner side of the crossmember 1 is displaced by the inner section 31 of the insert part 30, an intermediate region 12 is also produced here between the joining point 5 and the plastic 7 forming the wall of the ventilation duct 2. The core of a mold used during the injection molding method has an outer diameter which corresponds to the inner diameter of the ventilation duct 2. During the injection molding method the insert parts 30 are therefore held fixedly in the basic body 1. Retaining arms 32 which penetrate the basic body 1 in the case of the central and right-hand insert parts 30 in the illustration extend essentially radially outward from the inner sections 31 and the joining

parts 4 are welded to them as holders or connections for further components.

List of designations

1	Basic body, crossmember	31	Inner section
2	Ventilation duct	32	Retaining arm
3	Component		
4	Joining part	a	Wall thicknes of the basic body
5	Joining point, weld seam		
6	Embossed structure	b	Wall thickness of the duct
7	Plastic		
8	Knob	c	Embossed depth
9	Outer side		
10	Web		
11	Inner side		
12	Intermediate region		
13	Hole		
14	Bent-outward part		
15	Limb		
16	Eyelet		
17	Aperture		
18	Rib		
19	Side wall		
20	Base surface		
21	Supporting limb		
22	Fastening limb		
23	Hole		
24	Hole		
25	Embossed structure		
26	Opening		
27	Fastening arm		
28	Notch		
29	Ribbed structure		
30	Insert part		